Solutions for Sustainable Mobility

22nd ITS World Congress
Bordeaux, France
5 to 9 October
2015

TOWARDS INTELLIGENT MOBILITY
Better use of space

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SIS69 - Combining ITS and transport models - a promising win-win for urban traffic management

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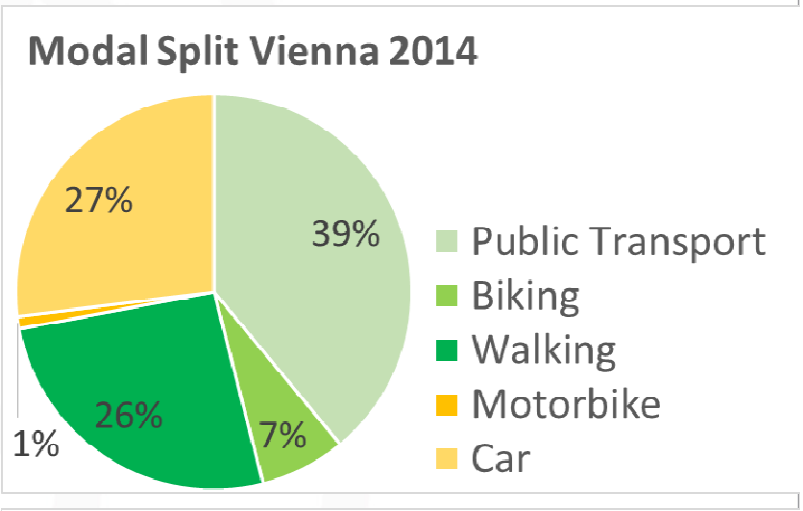
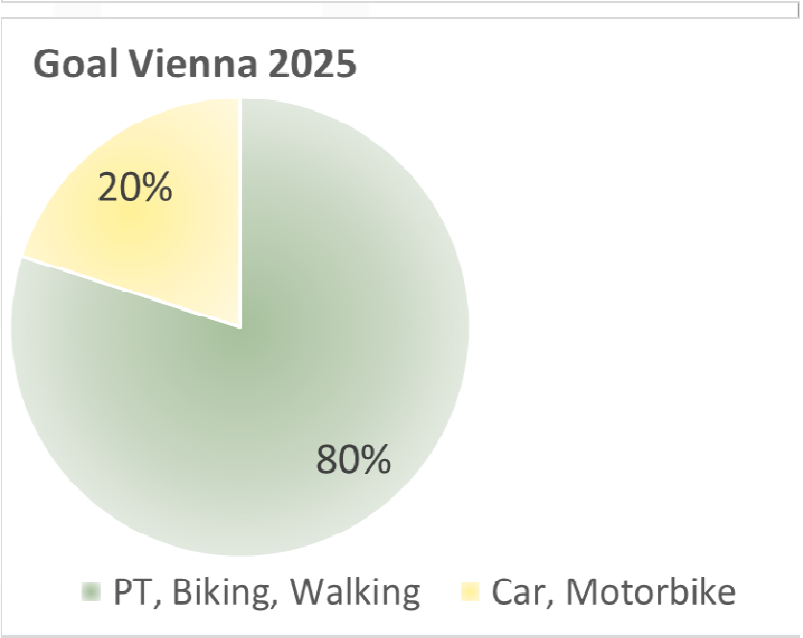
Setting the Theme

How does high quality urban traffic look like, which are quality targets for urban traffic?

- Shift viewpoint: Replace TRAFFIC by MOBILITY, as this expected by citizens
- Mobility is a complex topic comprising coupled and non-linear interacting systems
- Simulation of sub-systems
- Elasticity of interaction
- Modal composition of urban mobility
- Avoiding delays, congestion, emissions, …
- Goals: reliable travel, quick, convenient, cheap, clean, informed, …
- **How to compare apples and oranges?**





Source: https://www.wien.gv.at/rk/msg/2015/02/10006.html

What is traffic quality?

Hard to quantify & compare – use KPIs!

Examples for KPIs

KENTTS Study - KPIs of European Nationwide Truck Tolling Schemes

KPIs related to Financial Aspects

- KPI_1: Levying Performance
- KPI_2: Full-Cost-Income Ratio
- KPI_3: Total Investment per km

KPIs related to Setup and Operation

- KPI_4: Speed of Setup for the ETC Scheme
- KPI_5: Punctuality of System Start
- KPI_6: Network Enlargement

KPIs related to System Properties

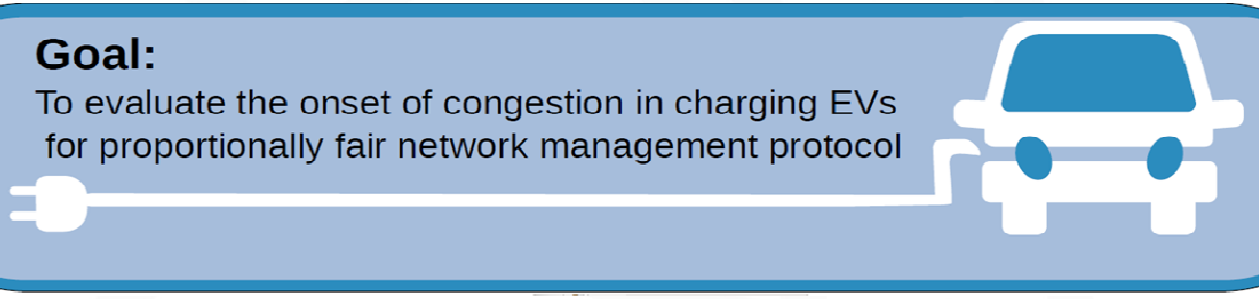
- KPI_7: Single System
- KPI_8: Interoperability
- KPI_9: Internationality

KPI related to Socio-economic Data

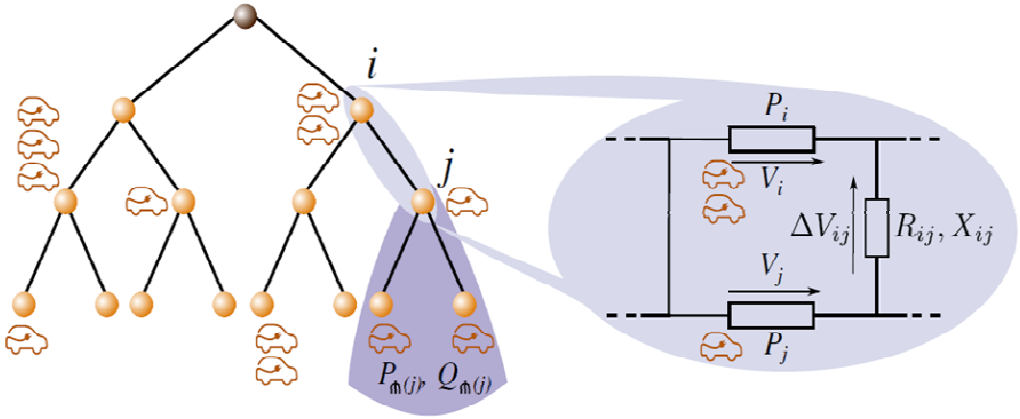
- KPI_{10}: Economic Compatibility

Congestion control in charging of electric vehicles

Goal:
To evaluate the onset of congestion in charging EVs for proportionally fair network management protocol



Application of **convex optimization** and **fair optimization** to green energy and transportation.



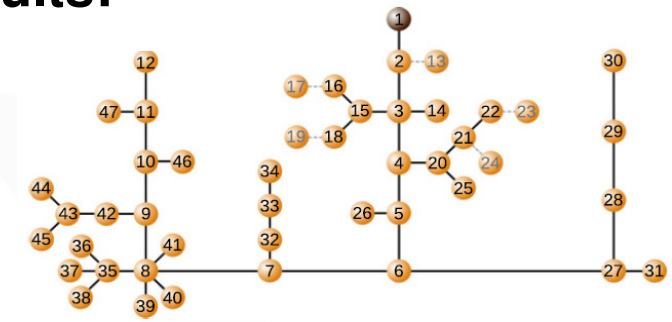
Main modelling assumptions:

- radial network topology
- EVs are price elastic loads,
- EVs arrive following Poisson process with empty batteries and leave when fully charged,
- network capacity is limited by voltage drop.

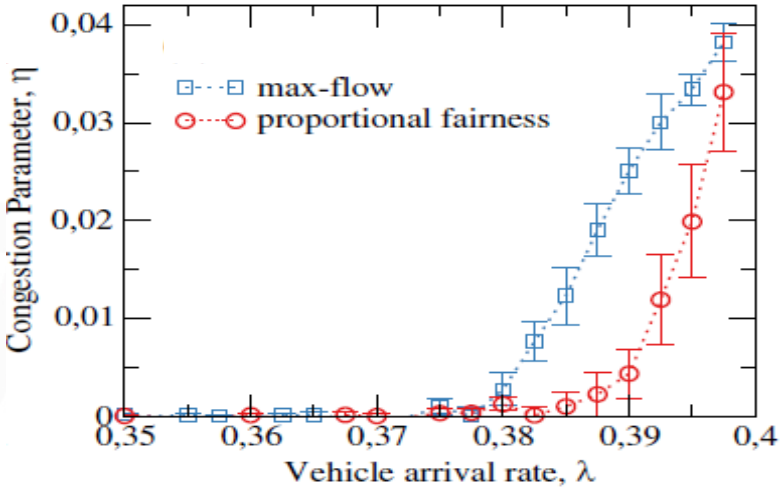
R. Carvalho, L. Buzna, F. Kelly, R. Gibbens, Critical behavior in charging electric vehicles, New Journal of Physics, **17**, 095001, 2015.

Congestion control in charging of electric vehicles

Results:



SCE 47-bus network



Conclusions:

- We studied a continuous phase transition from free-flow to the congested phase as the number of charging EVs grows for max-flow and proportional-fairness protocols;
- Max-flow leads to much more unequal charging times than proportional fairness;
- The critical arrival rate depends on the congestion control method and surprisingly the greediness of max-flow can be sub-optimal in relation to proportional fairness, with a cross-over effect as the arrival rate increases;

R. Carvalho, L. Buzna, F. Kelly, R. Gibbens, Critical behavior in charging electric vehicles, New Journal of Physics, **17**, 095001, 2015.

Further Information

http://www.wissenschaft-aktuell.de/artikel/Gerechtes_Stromnetz__Optimiertes_Aufladen_von_Elektroautos1771015589961.html

http://phys.org/news/2015-09-millions-electric-vehicles.html

Thank you for Your Attention!

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